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O. G. HANKINS AND L. B. BURK



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SOME RELATIONSHIPS AMONG FACTORS IN THE PRODUCTION AND GRADE OF BEEF

O. G. HANKINS AND L. B. BURK

U. S. Department of Agriculture

Recent years have witnessed a markedly increasing public interest in graded meats. This was preceded and has been accompanied, in the industry and among research workers, by an appreciation of the necessity of ascertaining the factors having an influence on the grade of meat animals and meats, of determining their relative importance and how to control them.

Opportunity for study along this line has been afforded in connection with the national project, "Cooperative Meat Investigations." The present report, which is preliminary and touches only a few of the more important points, deals with certain grading and related production data from 2,073 cattle used in a large number of experiments during the first three years of the investigations. These data were obtained through the cooperation of the Department and 18 state experiment stations, including Arkansas, Colorado, Illinois, Indiana, Iowa, Louisiana, Michigan, Mississippi, Missouri, Montana, Nebraska, New Mexico, Ohio, South Carolina, Texas, Virginia, West Virginia, and Wyoming.

The experiments which were involved varied greatly as to nature and objective. In consequence there were marked variations among the cattle as a whole with reference to factors such as feeder grade, age, finishing, ration fed, weights, gains, slaughter cattle and carcass grades. These variations proved of definite advantage in the present study.

Each individual, first as a feeder, next as a slaughter animal, and finally as a dressed carcass was given detailed consideration with respect to various visual characteristics, regarded as grade factors, by a committee of three qualified men representing the cooperating agencies. Each grader recorded independent judgment on each of the factors appearing on the grading charts, the average of the total scores on the three charts being considered the official grade for the animal or carcass as a unit. For the individual items the average of the three opinions was also taken as official.

The grading charts employed are well-known to many of

you. They were adopted by the conference of cooperators on the national project for use in the work. The feeder cattle and slaughter cattle charts in their original form have been published in Department Bulletin 1464. Copies of the three charts may be obtained from the Department on request. Six major grades of equal magnitude appear on the feeder cattle chart and seven each on the slaughter cattle and beef carcass charts. Each major grade is divided into three subgrades. The feeder cattle grades are designated as Fancy, Choice, Good, Medium, Common, and Inferior; the slaughter cattle and beef carcass grades as Prime, Choice, Good, Medium, Common, Cutter and Low Cutter.

RELATIONSHIPS AS SHOWN BY CORRELATIONS

Extensive analysis of data from the 2,073 cattle and carcasses was made by means of correlation. Determination was made, among other things, of the value of certain feeder-cattle characteristics as indices of feeder-cattle grade. The characteristics considered were width of body, depth of body, thickness of finish, shape of head, and refinement. These were involved, with a number of other characteristics, in determining the total score representing the grade of the feeder animal. Since these five factors had a part in determining feeder-cattle grade one would expect at least a moderately high correlation between each of them and the grade of the feeder. This proved to be the case but it is of particular interest that all five coefficients were very high, four exceeding .90. Width of body was found to be the best index of feeder-cattle grade, with a correlation coefficient of $+.96 \pm .001$, and thickness of finish the second best. Refinement appeared the least valuable of the five. In that instance the coefficient was $+.85 \pm .004$.

As an index of the ability of the animal to gain rapidly in the feed-lot none of the five feeder-cattle characteristics which have been mentioned, nor feeder-cattle grade, was found to have much value. Of the six factors, shape of head showed the highest correlation with rate of gain but the coefficient was only $+.13 \pm .015$.

Feeder grade and total gain in the feed-lot are two factors commonly regarded as having important influences on carcass grade. The correlation of the former with carcass

grade, for the 2073 cattle, was found to be $+.69 \pm .008$, of the latter $+.66 \pm .008$. The corresponding coefficients of determination are .48 and .44. It will be noted that they are approximately equal and each indicates a determination of carcass grade of slightly less than 50 per cent by the factor alone or when considered as a single factor unrelated to others. The average feeder grade of the 2,073 cattle was High Good, the average gain in the feed-lot 346 pounds, and the average carcass grade Middle Good.

The relative influence of rate of gain on carcass grade is indicated by a correlation coefficient of $+.37 \pm .013$ and the corresponding coefficient of determination of .14.

The problem of grading beef on the hoof with accuracy is one which commands the interest and attention of many people. In this work effort was made in all cases to have the same three men grade both the slaughter animal and the carcass. With few exceptions they did so and there was thus provided the ideal condition for throwing further light on this question. The slaughter-cattle and corresponding beef-carcass grades were found to be in close agreement in this work, the correlation coefficient being $+.86 \pm .004$.

Thickness of external fat, thickness of flesh, and uniformity of width of carcass were found to be very reliable indices of carcass grade. In all three cases the coefficient of correlation with carcass grade was well above $+.90$. Marbling of lean, firmness of fat, firmness of lean, color of fat, and color of lean were the other carcass characteristics considered in relation to carcass grade. They ranked in significance in decreasing order as mentioned, the highest coefficient being $+.90 \pm .003$ and the lowest $+.81 \pm .005$.

Any characteristic of the animal or of the unquartered carcass which would prove to be a thoroughly accurate indication of marbling would be of great value to the cattle and beef industry. Thickness of external fat was the one carcass characteristic, of those considered in this analysis, which was most highly correlated with marbling. The value was $+.88 \pm .003$. Thickness of flesh and uniformity of width of carcass were also rather highly correlated with marbling. It appears from these results that a beef carcass with a very thick covering of external fat, very thick flesh and very uniform width may be expected in a great majority of cases to show abundant and extensive marbling.

INFLUENCE OF FEEDER GRADE AND TOTAL GAIN
ON CARCASS GRADE

The influence of feeder grade and total gain on carcass grade is a matter of far-reaching interest and importance. It was considered briefly in a preceding paragraph and with reference to the total number of cattle involved. In the following, more-detailed discussion only data from steer calves, with initial weights of 400 pounds or more, are considered. Among the total of 2,073 cattle there were 441 such calves. Fifty-one of these calves were graded Fancy as feeders, 261 Choice, 106 Good, and 23 Medium. The respective average initial weights were 525, 458, 454, and 484 pounds.

In the analysis of the data each grade of feeders was subdivided according to the total gain made during the feeding period, and the distribution and average of carcass grades were determined for each subdivision. The ranges of gains employed in making these subdivisions were as follows: Up to 200 pounds, 200 to 279 pounds, 280 to 359 pounds, 360 to 439 pounds, 440 to 519 pounds, 520 pounds and over. The actual range of gain for the first subdivision was from 120 to 199 pounds, and for the last subdivision 520 to 690 pounds.

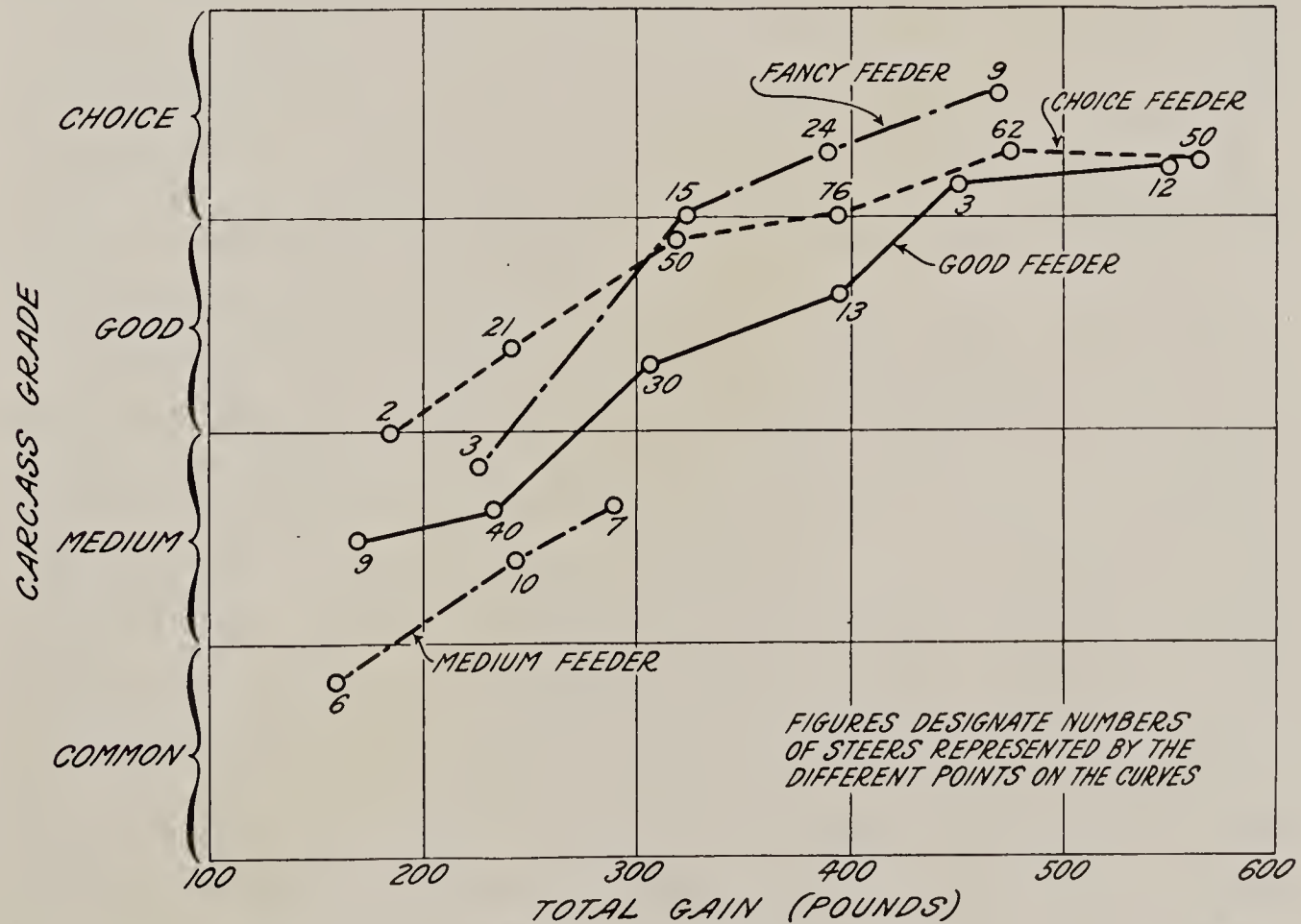


Chart 1. Influence of feeder grade and total gain in feed lot on carcass grade. (Feeder steer calves with initial weights of 400 pounds or more).

Chart 1 shows the relationships between feeder grade, total gain during the feeding period, and carcass grade for these steer calves. It is well to note first that as feeder grade decreased the gain required for maintenance of grade, from feeder to carcass, also decreased. The Fancy grade feeder steer calves, although gaining a maximum of 471 pounds, did not produce Prime grade carcasses. Choice grade feeders produced Choice grade carcasses after gaining approximately 380 pounds; Good feeders produced Good carcasses after gaining approximately 270 pounds, and Medium feeders produced Medium carcasses after gaining about 185 pounds.

The differences in total gain required by different grades of feeders to produce a specific grade of carcass are a matter of distinct interest and importance. It may be observed, for example, that these Fancy, Choice, and Good grade calves yielded Choice grade carcasses after gains of approximately 310, 380, and 460 pounds, respectively, allowing for smoothing of the curves. The relatively high initial weight (525 pounds) of the Fancy grade calves may have been responsible in part for the production of Choice grade carcasses after only 310 pounds gain, but in view of the clear-cut comparative results from the Choice and Good grade feeders it is believed that the principle of less gain being required by the higher-grade calves is definitely shown.

With one exception there is no overlapping of the curves representing the four grades of feeders. On account of the small number of individuals represented by the first point on the curve for Fancy grade cattle, the exception is not regarded as significant. Another of the important results shown is the relatively small range in average carcass grades at any given point of gain. By assuming a slight projection of the curve for Medium grade feeders it is possible to compare the average carcass grades of the four grades of feeder cattle after a common gain of 325 pounds had been made. In so doing a range of about 1.2 grades is shown, this representing the difference between the average carcass grades of the cattle which were Fancy and those of Medium grade as feeders. At 400 pounds gain Fancy, Choice and Good grade feeders may be compared and they show a range in carcass grade of about .7 of a

grade. These three grades of feeders continued to show about this same range in carcass grade at 465 pounds gain, although before that stage is reached there is a definite tendency for the Choice grade curve to flatten off, or cease to show an increase in grade of carcass, and to join the Good grade curve. The curve for Fancy grade feeders runs appreciably higher than the other two.

It is also shown by this chart that the rather narrow range in carcass grade at the stages of smaller gains is due to greater decline in grade, from feeder to carcass, by the higher than the lower-grading feeders. For example, if a typical Choice grade feeder steer calf weighing about 450 pounds as a feeder is slaughtered after a gain of 200 pounds in the feed-lot the carcass, according to the chart, will represent a decline of about 1.4 grades. Under similar conditions, however, the carcass of a Good grade steer calf would represent a decline of about .9 of a grade and Medium grade approximately .4 of a grade. It is estimated that the carcass of the Fancy feeder after the gain of 200 pounds would represent a decline of about 2 grades. Obviously, therefore, if advantage is to be taken of the potential ability of the higher-grading feeders to produce high-grade carcasses they must be fed for at least moderately high gains. In this connection it should be noted, however, that with the more extreme gains the Fancy grade feeders indicated a distinctive ability to yield carcasses of highest grade. The characteristics of lower-grade feeders are such that the carcasses of the animals, even though well-finished, are usually deficient in other respects.

To give in this report detailed results as to the influence of variation in initial weight within the feeder grade and in rate of gain in the feed-lot on carcass grade would require too much time. It is essential to state, however, that further analysis of the steer-calf data has shown in general the higher initial weights within the grade and the more rapid gains to have been associated with the higher grading carcasses, when total gains were equal. Although definite in their influence on carcass grade these two factors appeared as minor ones in comparison with feeder grade and total gain.

SUMMARY

Summarizing the more important facts,—width of body was found to be the best index of feeder-cattle grade among the five feeder characteristics considered. None of these, nor feeder-cattle grade, was a reliable index of ability to gain rapidly.

Feeder grade and total gain in the feed-lot had approximately equal influence on carcass grade in the average case. There was a correlation of $+.86 \pm .004$ between slaughter cattle grade and carcass grade.

Thickness of external fat, thickness of flesh, and uniformity of width of carcass were the best indices of carcass grade among the 8 carcass characteristics considered. All three correlations were well above $+.90$.

Thickness of external fat was the best index of marbling, with a correlation of $+.88 \pm .003$.

Among the steer calves, as feeder grade decreased the gain required to maintain grade, feeder to carcass, also decreased. However, the gain required to produce a uniform grade of carcass increased.

Fancy grade feeders indicated a potentiality for producing Prime grade carcasses, which the other grades did not appear to possess. However, greater decline, feeder grade to carcass grade, was shown by the higher than by the lower-grading feeders at the stages of smaller gains. The results indicated that if advantage is to be taken of the potentiality of higher-grading feeders for producing high-grade carcasses they must be fed for relatively large gains.

Variations in initial weight and rate of gain within the feeder grade were factors influencing carcass grade, but were minor in comparison with feeder grade and total gain.